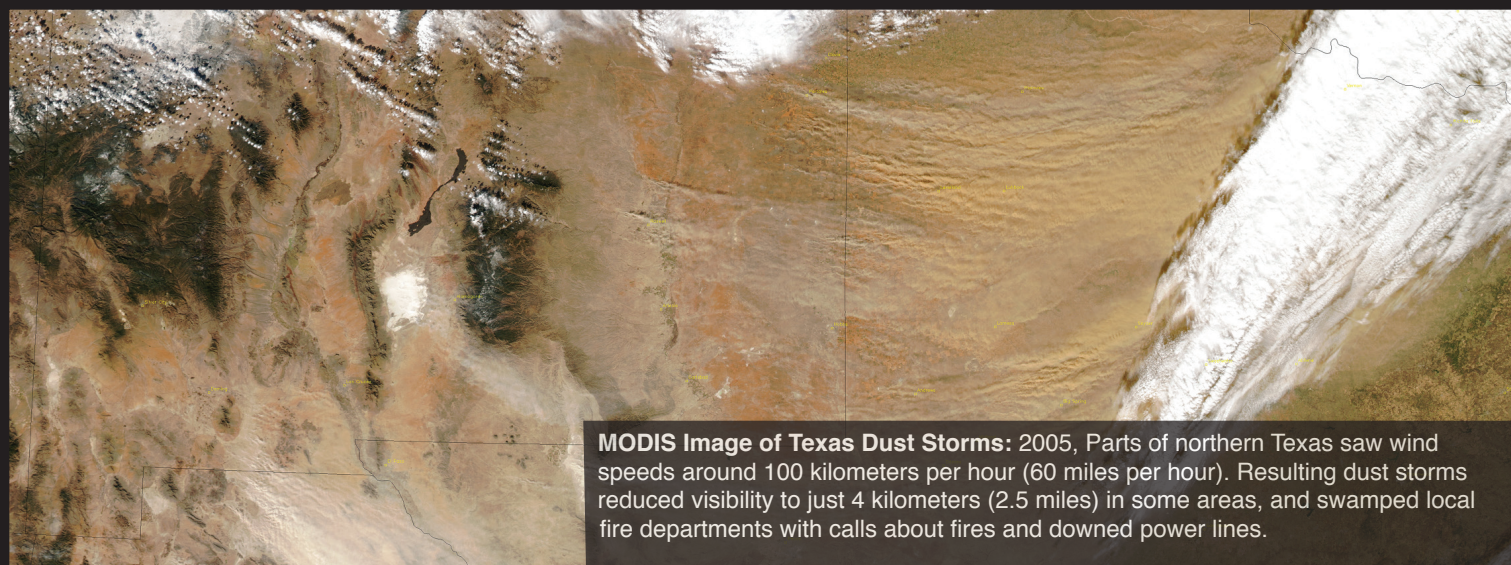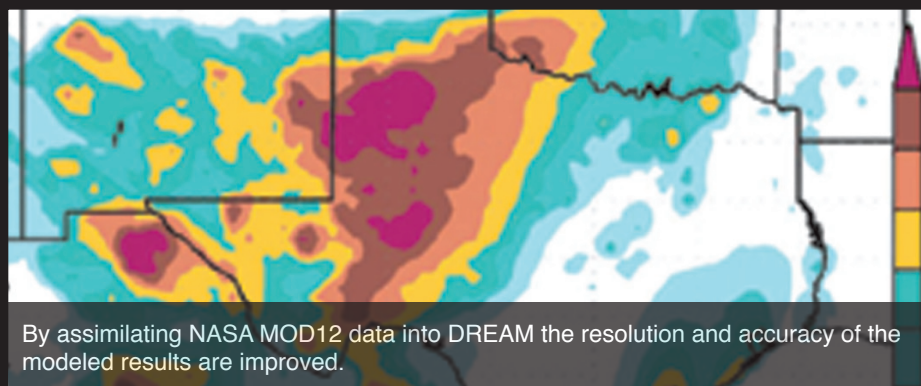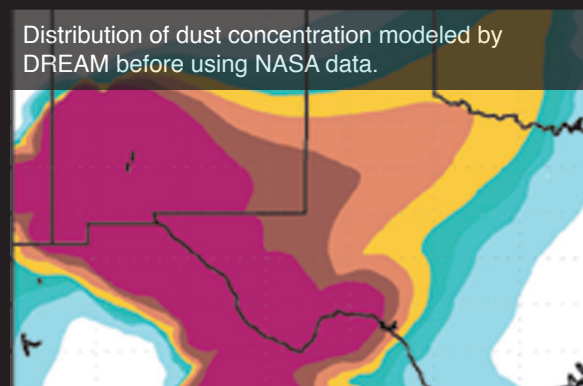# Forecasting Dust Events in the Southwest United States for Public Health Alerts

MODIS Image of Texas Dust Storms: 2005, Parts of northern Texas saw wind speeds around 100 kilometers per hour (60 miles per hour). Resulting dust storms reduced visibility to just 4 kilometers (2.5 miles) in some areas, and swamped local fire departments with calls about fires and downed power lines.

Distribution of dust concentration modeled by DREAM before using NASA data.

By assimilating NASA MOD12 data into DREAM the resolution and accuracy of the modeled results are improved.

Goals

Adapt Dust Regional Atmospheric Model (DREAM) to forecast dust events in the southwest United States

Use NASA MODIS products, such as land cover and topography data, to improve the performance of DREAM

Verify and validate improvements to DREAM using EPA AIRNow ground station data

Improve the operational Syndrome Reporting Information System through the integration of NASA - enhanced DREAM forecasts

Outcomes

Timely and accurate regional dust forecasts in the southwest United States

Provide information on impending dust events to public health officials, school nurses, and others who send alerts to persons with respiratory conditions such as asthma

Improve dust storm readiness and therefore help save money on damaged property and infrastructure

FS-2008-06-144-LaRC

Forecasting Dust Events in the Southwest United States for Public Health Alerts

Applying NASA Earth Observations to Improve Model Performance

Summary

The Public Health Applications in Remote Sensing (PHAiRS) project improved performance of the Dust Regional Atmospheric Model (DREAM) by assimilating data from NASA's MODIS (onboard the Terra and Aqua satellites) and the Shuttle Radar Topography Mission (SRTM) sensors. DREAM forecasts dust patterns and concentrations by being nested within, and driven by, a U.S. National Weather Service operational numerical weather forecast model. The project works closely with state public health, environment, and air quality offices which monitor air quality for public health conditions in the Southwest United States. The ultimate goal of this project is to contribute to an improved public health decision support system and to provide information on impending dust events to public health officials who issue early warnings on adverse environmental conditions.

Societal Benefits

Increases in particulate matter, specifically dust in the air has been known to trigger asthma symptoms and respiratory problems. Asthma is one of the most common chronic diseases in the United States and is the most prevalent chronic disease in children. The rate of asthma among children in the northern mid-latitudes has more than doubled in the last 20 years. It is the most common reason that children younger than five go to the emergency room. Based on outpatient visits, the prevalence of asthma has increased by 50 percent over the last decade.

Economically, there is ample evidence that respirable particulates result in costly health effects. Direct health care costs for respiratory ailments, like asthma, currently exceed $11.5B annually. Indirect costs (lost productivity) add another $4.6B. Annual treatment costs in 2003 were over $4,900 per asthmatic. Forecasting dust events and issuing early warnings to the public may help reduce the number of emergency room visits, as well as missed school and work days. This translates into economic savings in health care and revenue due to lost productivity.

Project Details

The project has three goals. The first focuses on assimilating satellite data from NASA's Terra and other platforms into a baseline version of DREAM developed originally for use in the Mediterranean region. This model was adapted for use in the Southwest United States. The aim is to: (a) verify that satellite data can replace initial parameters to improve the model's performance; and (b), validate that parameter replacements can lead to more refined model forecasts of dust episodes. The second goal is to optimize model outputs by iterating inputs with a variety of satellite products and assessing incremental improvements to the Syndrome Reporting Information System (SYRIS), which maps reported cases of respiratory distress. The third goal is to establish collaborative relations with public health communities to develop statistically valid relationships between dust episodes and increased respiratory complaints.

Meteorological fields modeled by the enhanced DREAM are generally in agreement with measured observations. Comparing model runs before and after assimilating NASA data showed that sea level pressure, 500 hPa geopotential height, and temperature patterns matched well with traditional weather observations. Improvements to model performance are observed by assimilating MODIS data on land cover and land surface features into DREAM. The model forecasts the timing of dust storm events significantly better at almost all locations in the model domain, but has variable success in forecasting dust concentrations.

While there are lags in the model's timing and dust concentration averaging, there are promising results from enhanced model runs, which indicate that data replacements improve dust episode forecasting in two out of three cases. NASA dust storm predictions are being integrated into a computer-based decision-support system, SYRIS. Ultimately, the system could allow health officials to issue early warnings to populations at risk for dust-related health complications.